Green-Mode PWM Controller below 100mW Standby Power

Features

- Current mode PWM control
- Standby power below 100mW solution
- Under voltage lockout (UVLO)
- Non-audible-noise green-mode control
- Programmable switching frequency
- Internal leading-edge blanking
- Internal slope compensation
- Internal soft start
- Gate output voltage clamp
- Jitter and soft driving for reducing EMI
- Over-voltage protection (OVP) on VCC pin
- Over-load protection (OLP)
- Over-current protection (OCP) on CS pin

Applications

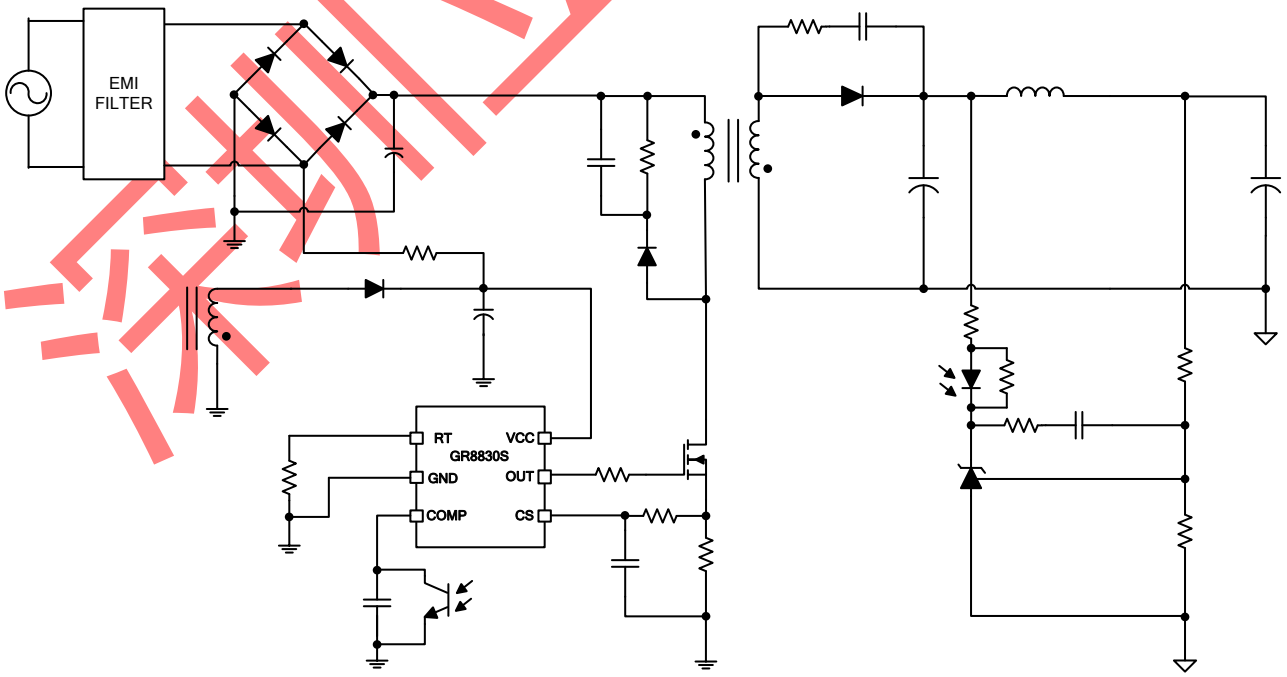
- Switching AC/DC power adaptor
- Battery charger
- Open-frame SMPS

Description

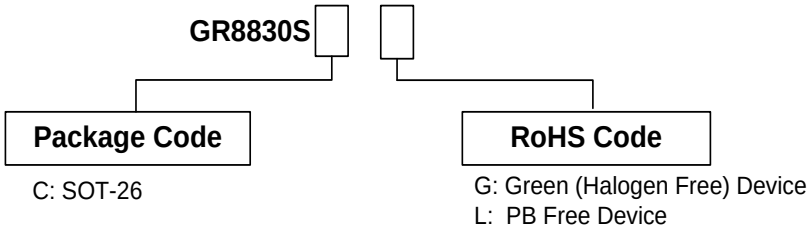
The GR8830S is a highly-integrated, low startup current, current mode PWM controller with Green-mode function. This function enables the power supply to easily meet even the strictest power conservation requirements. The integrated functions also include the leading-edge blanking of the current sensing, internal slope compensation, cycle-by-cycle peak current limiting, and soft start. OLP, OCP and OVP provide protection performance for fault conditions. For protecting the external power MOSFET from being damaged by supply over voltage, the GR8830S OUT pin voltage is clamped to about 12.5V.

The GR8830S improves the performance and reduces the cost of power supplies. It is with SOT-26 package.

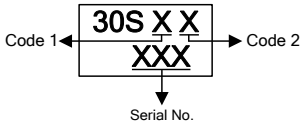
Typical Application Circuit



Ordering and Marking Information



SOT-26

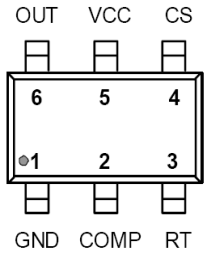


Code 1	8	9	A	B		G	H	I	J
Year	2008	2009	2010	2011	. . .	2016	2017	2018	2019
Code 2	1	2	3	4		9	A	B	C
Month	Jan.	Feb.	Mar.	Apr.		Sep.	Oct.	Nov.	Dec.

Grenergy OPTO Inc. reserves the right to make changes to improve reliability or manufacture ability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Pin Configuration

SOT- 26 (TOP VIEW)



Pin Description

Pin No.	Name	Function
1	GND	Ground
2	COMP	Voltage feedback pin, by connecting a photo-coupler to control the duty cycle
3	RT	Connecting a resistor to ground to set the switching frequency
4	CS	Current sense pin, connect to sense the MOSFET current
5	VCC	Power Supply pin
6	OUT	The output driver for driving the external MOSFET

Absolute Maximum Ratings

Supply voltage VCC ---------- 30V

COMP, RT, CS ---------- −0.3 ~ 7V

OUT ---------- −0.3 ~ Vcc+0.3V

Junction temperature ---------- 150℃

Storage temperature range ---------- −65℃ ~ 150 ℃

SOT-26 package thermal resistance ---------- 250℃/W

Power dissipation (SOT-26, at ambient temperature = 62.5℃) ---------- 250mW

Lead temperature (All Pb free packages, soldering, 10 sec) ---------- 260℃

ESD voltage protection, human body model ---------- 2KV

ESD voltage protection, machine model ---------- 200V

Protection Mode

OLP	VCC OVP	Internal OTP
Auto recovery	Auto recovery	Auto recovery

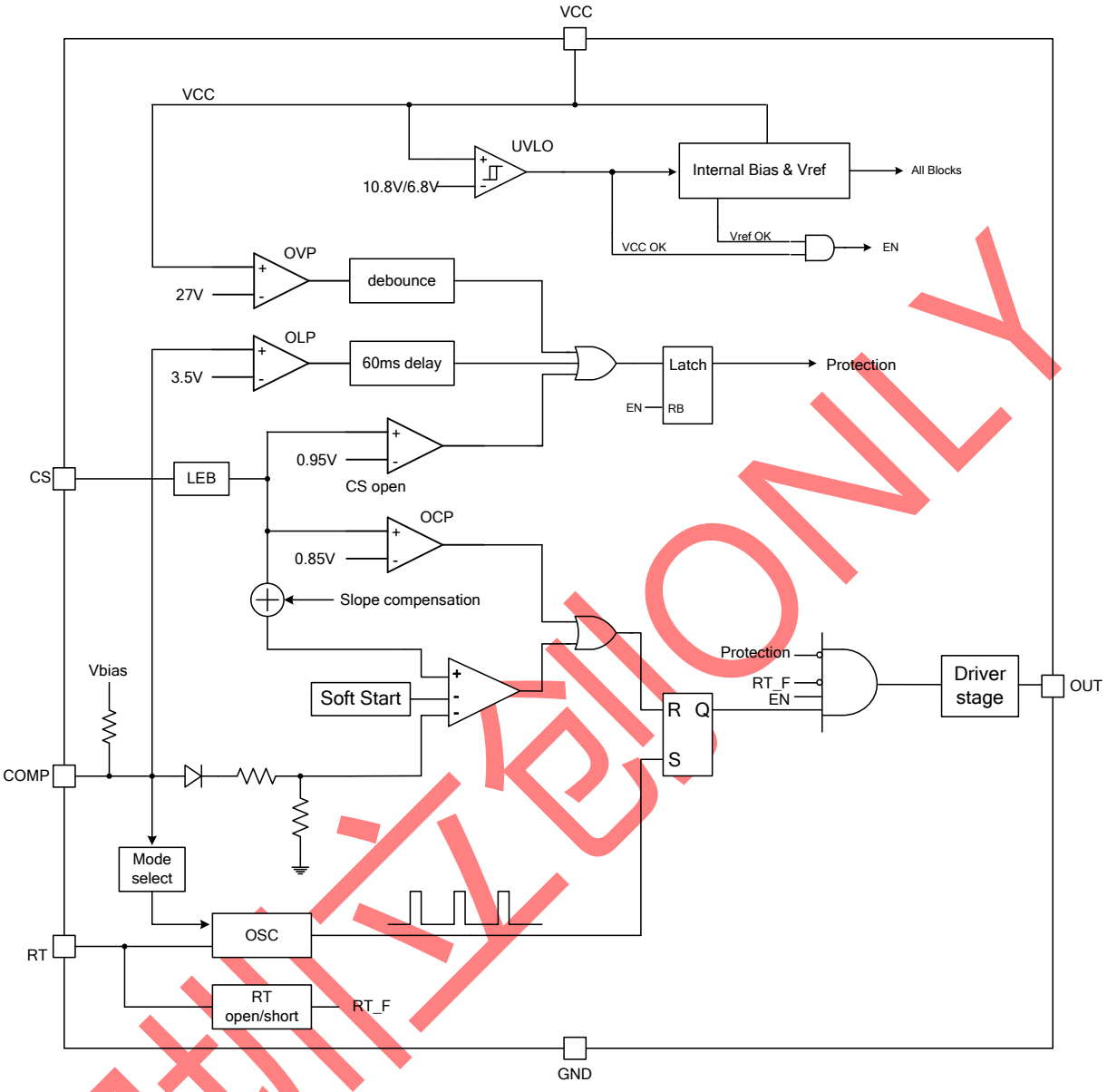
Recommended Operating Conditions

Item	Min.	Max.	Unit
Operating Junction temperature	-40	125	℃
Operating ambient temperature	-40	85	℃
Supply voltage VCC	10	25	V
CS Pin Capacitor Value	100	1000	pF
COMP pin paralleling capacitor	1	33	nF
Switching frequency	50	130	kHz

Note:

- Not to exceed the maximum junction temperature of the IC, this relates to the operating power of the IC and the thermal resistance of the IC-package as above.
- The small signal components should be placed to IC pin as possible.
- It's essential to connect VCC pin with a SMD ceramic capacitor (0.1μF~0.47μF) to filter out the switching noise for stable operation.
- Connecting a capacitor to COMP pin is also essential to filter out the switching noise for stable operation.

Block Diagram



Electrical Characteristics (VCC = 15.0V and TA = +25℃,unless otherwise specified)

Parameter	Pin	Min.	Typ.	Max.	Unit
SUPPLY VOLTAGE					
Startup current (VCC=UVLO(on)-0.1V)	5		8.5	12	uA
Operating current (with 1nF load on OUT pin), Vcomp = 0V	5		0.9		mA
Operating current (with 1nF load on OUT pin), Vcomp = 2.5V	5		1.8		mA
Operating current (with 1nF load on OUT pin), protection tripped (OLP, OVP)	5		0.45		mA
UVLO (off)	5	6.3	6.8	7.3	V
UVLO (on)	5	10.3	10.8	11.3	V
VCC Mode Entry Point	5		8.5		V
VCC Mode Hysteresis	5		0.25		V
OVP level on VCC pin	5	25.5	27	28.5	V
VOLTAGE FEEDBACK					
Open loop voltage, COMP pin open	2	4.4	4.7	5.0	V
Short Circuit Current	2	0.4	0.5	0.6	mA
Green-mode threshold voltage*	2		1.8		V
Burst Mode Threshold voltage, Vcomp	2	0.8	0.9	1	V
Burst Mode Hysteresis	2	0.07	0.1	0.13	V
CURRENT SENSING					
Maximum input voltage, Vcs(max) (Duty>56%*)	4	0.8	0.85	0.9	V
Minimum input voltage, Vcs(min) (Duty<13%*)	4	0.52	0.57	0.62	V
Leading-edge blanking time	4	295	350	405	ns
Input impedance	4	1			MΩ
Delay to output*	4		100		ns
OSCILLATOR					
Frequency (RT = 100kΩ)	3	60	65	70	kHz
Jitter frequency	3		±6		%
Green mode frequency (RT = 100kΩ)	3	20	22	26	kHz
Temp. stability (−20°C ~ 110°C)*	3		3		%
Voltage stability (Vcc = 11V ~ 25V)*	3		1		%
GATE DRIVER OUTPUT					
Output low level, VCC = 15V, Io = 5mA*	6			1	V
Output high level, VCC = 15V, Io = 5mA*	6	8			V
Rising time, load capacitance = 1000pF*	6		300	350	ns
Falling time, load capacitance = 1000pF*	6		80	100	ns
VGATE-clamp (at VCC = 20V)	6	11.5	12.5	13.5	V

*Guaranteed by Design.

Electrical Characteristics (VCC = 15.0V and TA = +25℃,unless otherwise specified)

Parameter	Pin	Min.	Typ.	Max.	Unit
OLP					
OLP trip level, Vcomp (OLP)	-	3.2	3.5	3.9	V
OLP delay time, (RT = 100kΩ)	-	67	79	91	ms
OLP delay time, (RT = 65kΩ)*	-		51		ms
PWM Section					
Maximum duty cycle	-	70	75	80	%

*Guaranteed by Design.

Typical Performance Characteristics

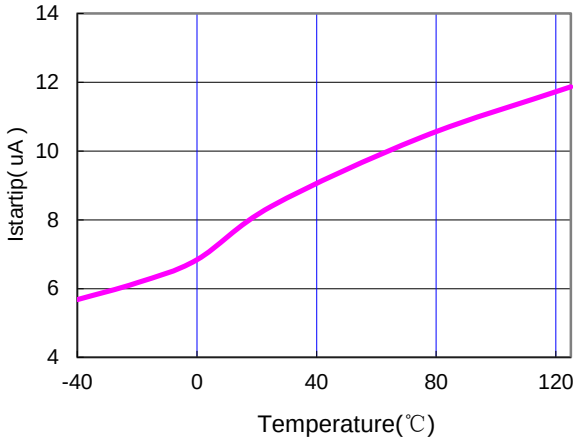


Fig. 1 Istartup current vs. Temperature

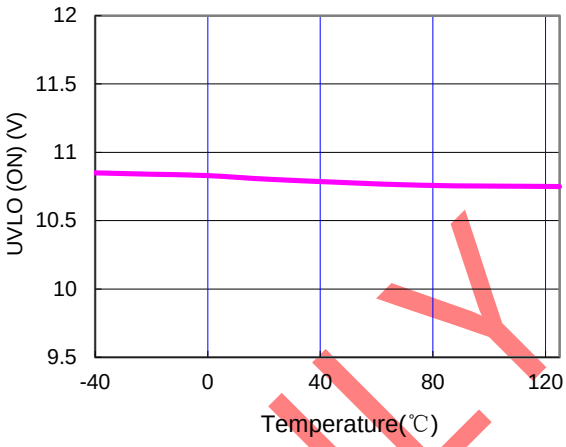


Fig. 2 UVLO (ON) vs. Temperature

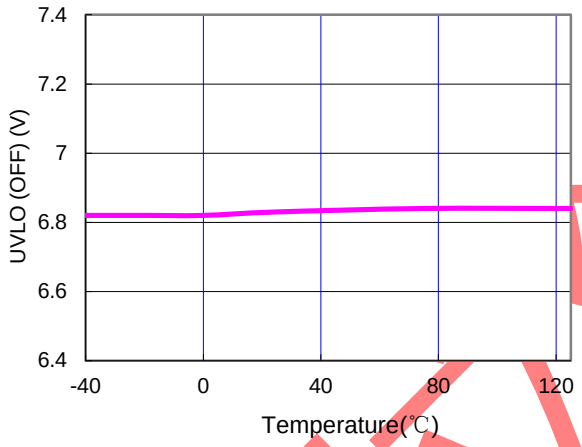


Fig. 3 UVLO (OFF) vs. Temperature

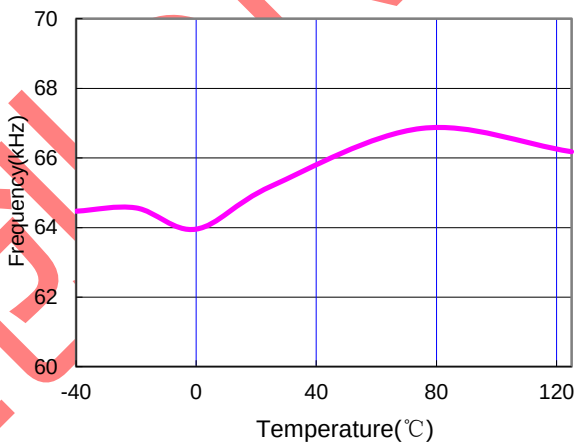


Fig. 4 Frequency vs. Temperature

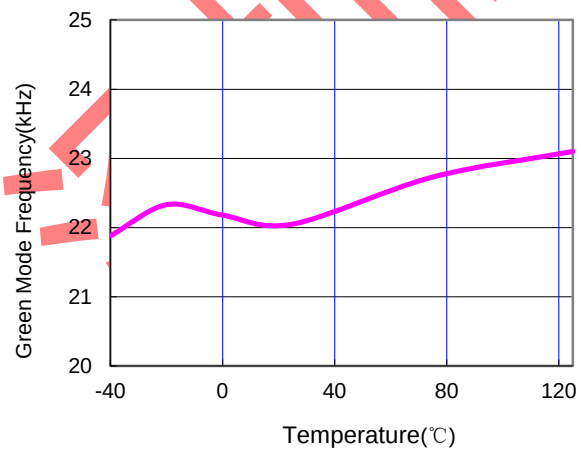


Fig. 5 Green Mode Frequency vs. Temperature

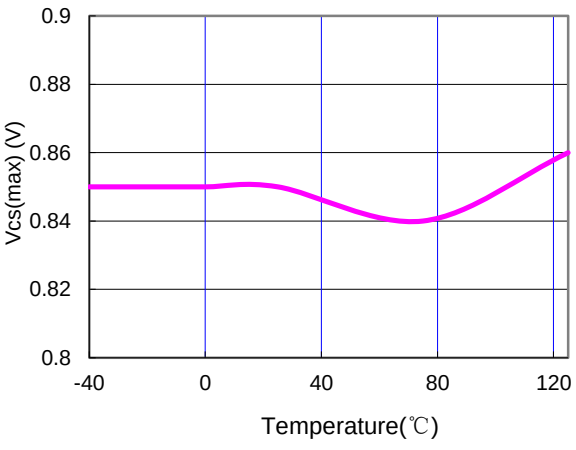


Fig. 6 Vcs(max) vs. Temperature

Typical Performance Characteristics

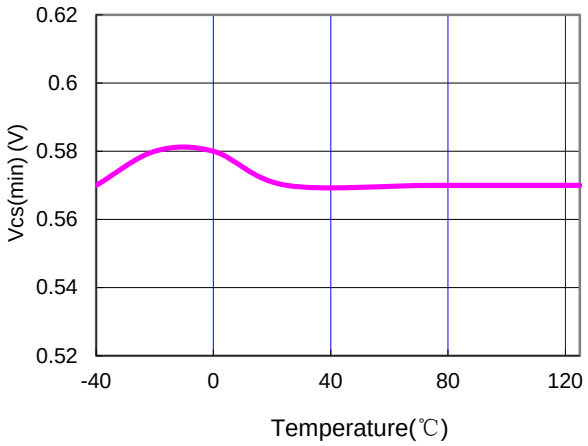


Fig. 7 Vcs(min) vs. Temperature

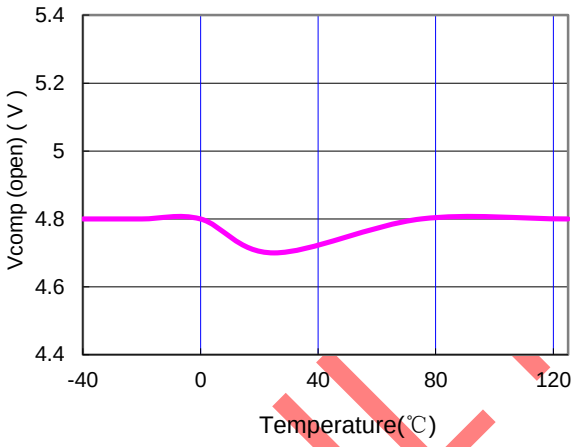


Fig. 8 Vcomp open loop voltage vs. Temperature

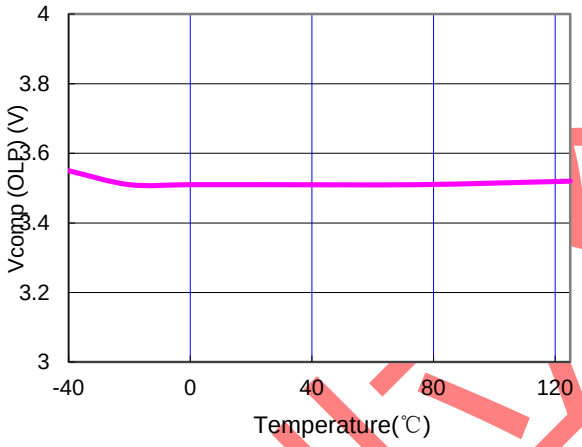


Fig. 9 Vcomp (OLP) vs. Temperature

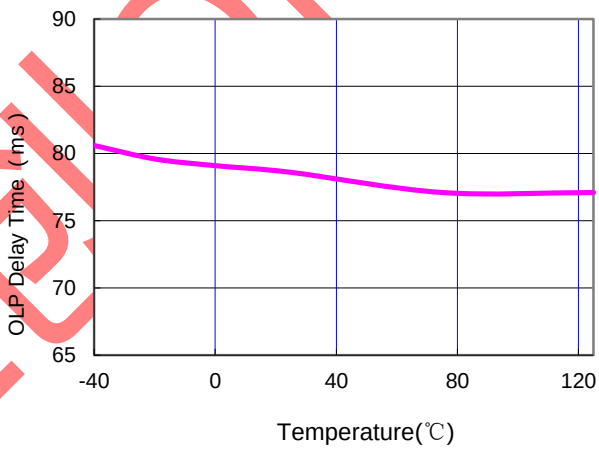


Fig. 10 OLP delay time vs. Temperature

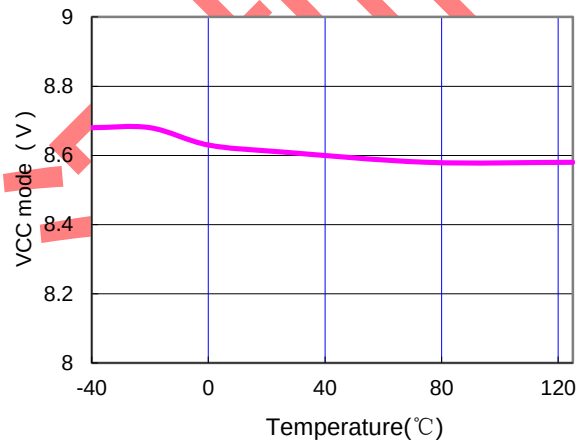


Fig. 11 VCC Mode (Entry) vs. Temperature

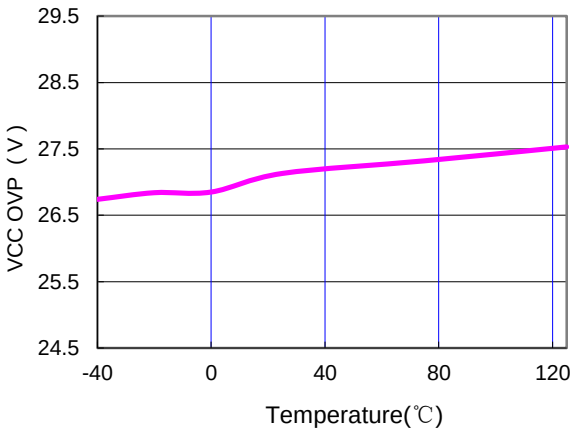


Fig. 12 VCC OVP vs. Temperature

Application Information

Start-up Current

The typical start-up current is around 8uA. Very low start-up current allows the PWM controller to increase the value of start-up resistor and then reduce the power dissipation on it.

Under-voltage Lockout (UVLO)

A hysteresis UVLO comparator is implemented in GR8830S, once the VCC rises above UVLO (on) voltage, the controller starts to switch with a soft start period. It will continue to operate unless the voltage drops below UVLO (off) voltage. It's operation is shown in Fig. 13

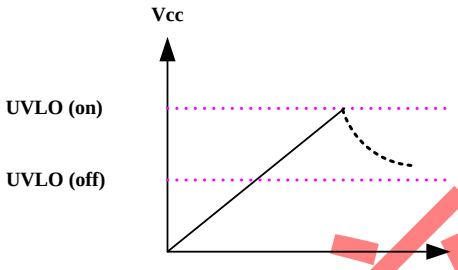


Fig. 13

Soft Start

During initial power on, the GR8830S provides 4ms soft start function. It effectively suppresses the start up peak current to reduce the power MOSFET drain voltage especially at high line.

Oscillator

The maximum duty-cycle of internal oscillator is limited about 75% to avoid the transformer saturation. The frequency of the oscillator is decided by an external resistor connected from RT pin to ground.

fosc= 6500kHz/R (kohm)

Where R is the resistor connected at RT pin. A 100kohm resistor results in 65kHz switching frequency. The recommended range of oscillation frequency is 50 KHz~130 kHz.

Green-Mode Operation

When the load decreases to an extent, the frequency of the controller will decrease so as to reduce the system power consumption. The minimum frequency is about 22kHz, which is outside the audio range. Fig. 14 shows the characteristics of the switching frequency vs. the comp pin voltage (Vcomp).

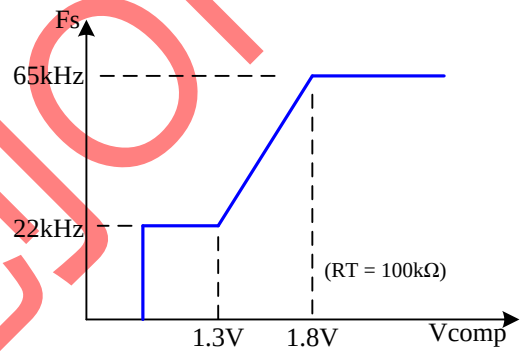


Fig. 14

Leading-edge Blanking (LEB)

Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and can not switch off the gate driver.

Internal Slope Compensation

A built-in slope compensation circuit is constructed in GR8830S. When the switch is on, a ramp voltage is added to the sensed voltage across the CS pin, which helps to stabilize the system and prevent sub-harmonic oscillations.

Application Information (Cont.)

Over-load Protection (OLP)

The controller has over load protection function. An internal circuit detects the load level, when the load is larger than a threshold and the condition lasts more than OLP delay time, the gate output will keep low level. Then VCC decreases below UVLO off level, the controller resets again. Fig. 9 shows the waveform of the OLP operation.

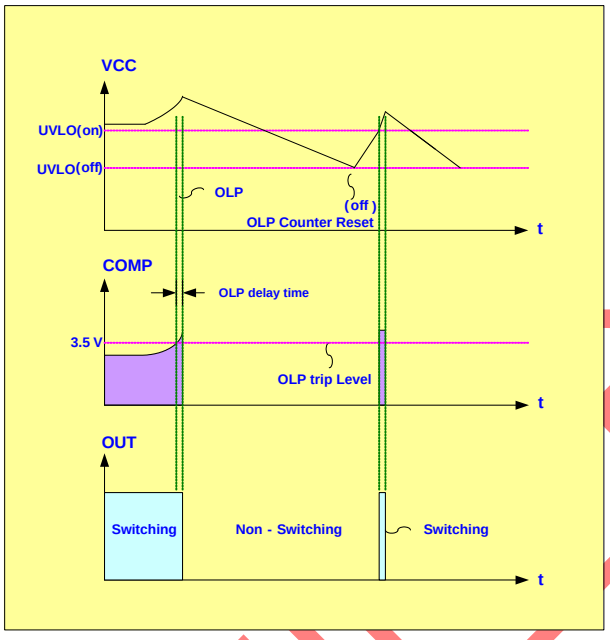


Fig. 15

Over-voltage Protection (OVP) on VCC

To prevent power MOSFET from being damaged, the GR8830S is implemented an OVP function on VCC. When the VCC voltage is higher than the OVP threshold voltage, the output gate driver circuit will be shut down immediately to stop the switching of power MOSFET. The VCC OVP function is an auto-recovery type protection. If OVP happens, the pulses will be stopped and recover at the next UVLO on. The GR8830S is working in a hiccup mode as shown in Fig. 16.

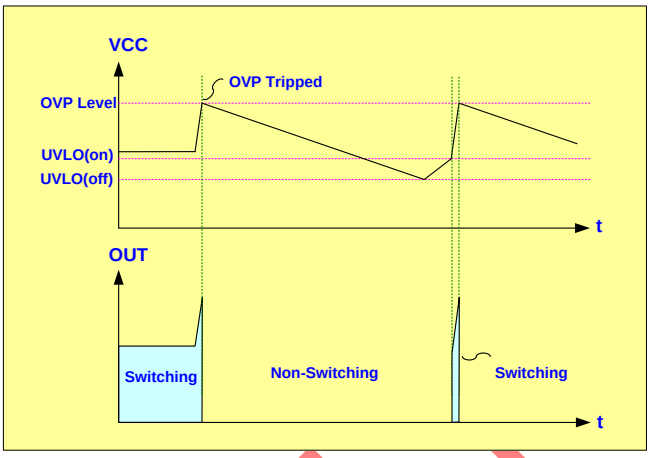


Fig. 16

Gate Clamp/Soft Driving

Driver is clamped to 12.5V by an internal clamping circuit.Those damages usually come from undesired over-voltage gate signals.Under the conditions listed below, the gate output will turn off immediately to protect the power circuit.The GR8830S also has soft driving function to minimize EMI.

VCC Mode Operation

In order to avoid the output voltage shut down by load changing from full to no load, the GR8830S is built-in the VCC mode function. When the load from full changes to no load, the output voltage will overshoot and pull low the COMP pin by feedback loop (Into burst mode). Thus the duty will disappear and no power delivers to the secondary. If there is without any mechanism to prevent this situation, the VCC pin voltage will down to UVLO off and the IC will re-start again. In the GR8830S, before the VCC is down to UVLO off, it will force the OUT pin outputs the specified duty to pull the VCC higher than UVLO off.

The VCC mode function is used to prevent the output re-start again when load changes. So never let the system operate on the VCC mode at no load. The system should operate on burst mode, otherwise the input power maybe become larger.

Application Information (Cont.)

Fault Protection

There are several critical protections integrated in the

. CS pin floating

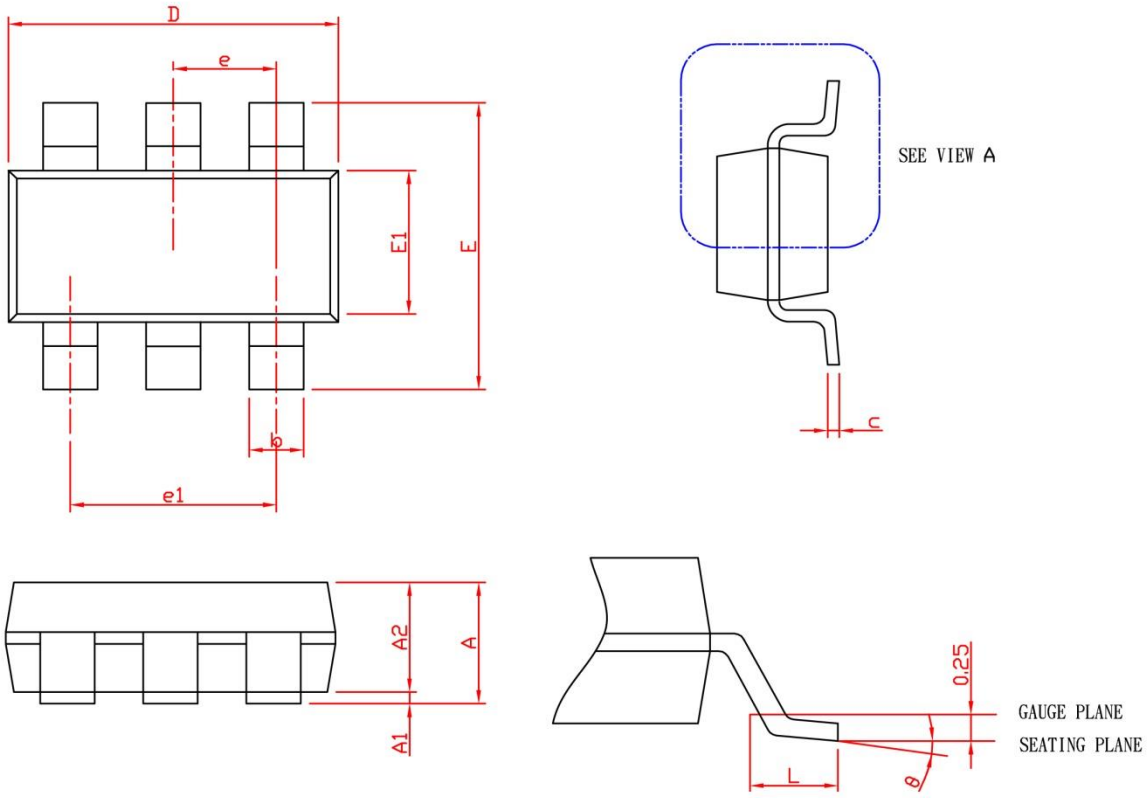
. Comp pin shorting

. Comp pin floating

. RT pin shorting

Package Information

SOT-26



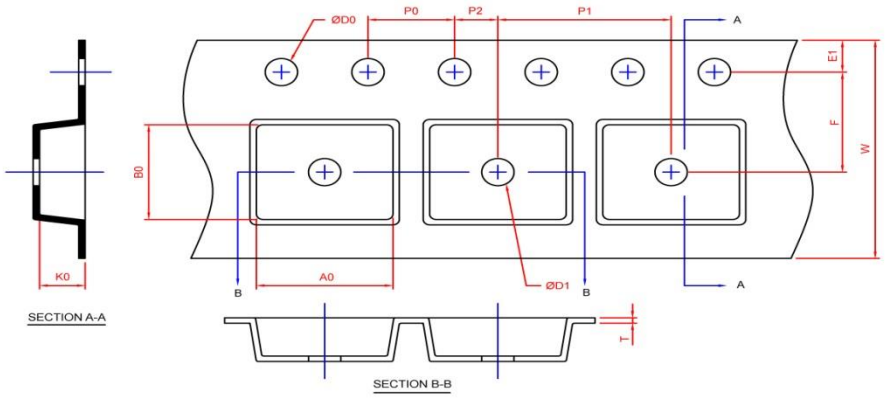
SYMBOL	SOT-26			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.60	0.012	0.024
θ	0°	8°	0°	8°

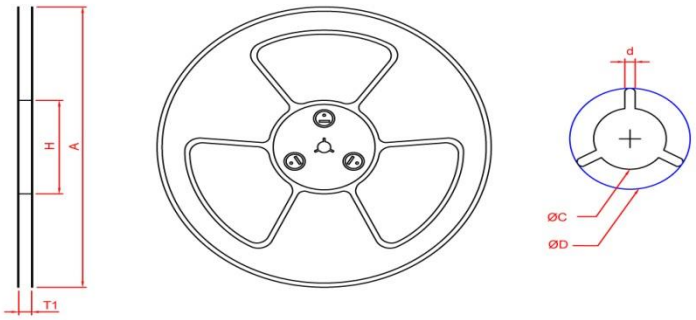
Note: 1. Followed from JEDEC MO-178 AB.

2. Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 10 mil per side.

Carrier Tape & Reel Dimensions

SOT-26





Application	A	H	T1	C	d	D	W	E1	F
SOT-26	178.0±2.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0±0.30	1.75±0.10	3.5±0.05
	P0	**P1**	**P2**	**D0**	**D1**	**T**	**A0**	**B0**	**K0**
	4.0±0.10	4.0±0.10	2.0±0.05	1.5+0.10 -0.00	1.0 MIN.	0.6+0.00 -0.40	3.20±0.20	3.10±0.20	1.50±0.20

(mm)

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOT -26	8	5.3	3000

Taping direction information

SOT-26